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ABSTRACT

This document contains a paper on strategic planning for regional economic development by David Passmore, and reactions to it from the 1988 Mid-Year Meeting of the University Council for Training and Development. Papers contained in this proceedings are as follows: "Strategic Planning of Employment and Training for Regional Economic Development" (David L. Passmore); "Some Perspectives on Passmore's Paper" (Fred L. Otte and John H. Preston); "Tinkerland and Training and Development: Setting the Research Boundaries and Aims" (Ronald L. Jacobs); "Coefficients for Strategic Planning: The Tinkerland Approach" (Gary D. Geroy); "Is Leontief's Model Appropriate for Regional Planning?" (Richard B. Armstrong, Jr.); "Holistic Approach to Regional Strategic Planning" (Glenn E. Baker); "A Private Sector Perspective on 'Strategic Planning of Employment and Training for Regional Economic Development'" (Gary N. McLean and Richard A. Swanson); and "Tinkerbell's Response" (Walter A. Cameron). (KC)

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Regional Strategic Planning for Employment and Training: Reality or Fantasy?

Gerald Cheek, Editor

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INTRODUCTION

This monograph grew out of the 1988 Mid-Year Meeting of the University Council for Training and Development. The Knoxville Meeting was sponsored by the Department of Technological and Adult Education, The University of Tennessee and Skills Development Department, Tennessee Valley Authority.

Since the Council and TVA are both interested in current and emerging research issues facing training and development, it was appropriate that a "guest researcher" prepare and present a paper to the Council for membership reaction. Dr. David L. Passmore was commissioned to prepare and present a discussion paper titled, "Strategic Planning of Employment and Training for Regional Economic Development."

A Research Forum Program was scheduled and Dr. Passmore presented an overview of his paper. Council members were provided an opportunity to react to his discussion paper and engage in dialogue with him on issues and points of interest, agreement, and disagreement. It was decided the following day by the membership that a monograph be published. The monograph would include Dr. Passmore's discussion paper and reactions from a representative(s) of the institutions with membership in the Council. Additionally, a reaction was solicited from Dr. Richard Armstrong of the Tennessee Valley Authority. The following is a list of the member institutions of the University Council for Training and Development Research:

Georgia State University	The Pennsylvania State University
University of Minnesota	Texas A & M University
The Ohio State University	The University of Tennessee

This monograph could have a variety of uses. Professionals involved in training and development should find Dr. Passmore's paper thought provoking and it should raise interesting questions on how workforce planning should be conducted. More importantly, it should make all of us aware of the complex problems involved in trying to project training needs to meet future demands. Each reactor has provided interesting insights and raised questions that must be answered in the future.

I would like to express my appreciation to Dr. Passmore and to each of the reactors from the member institutions. Additionally, a special thanks goes to Mr. Ken Cox, who worried with the format and provided his technical expertise in getting this monograph published.

It is my wish that each reader will gain from this monograph and use its contents to provide better training and development activities so desperately needed by our workforce.

Gerald Cheek
Head, Technological & Adult Education

Strategic Planning of Employment and Training for Regional Economic Development

David L. Passmore

INTRODUCTION

> *In developing an industrial strategy for the period ahead, we have had the benefit of much experience. Almost everything has been tried at least once.*
>
> – Tony Benn, *Observer*, *Sayings of the Week*, 17 March, 1974

Where do jobs come from? By the way otherwise intelligent people talk and behave, you could conclude that jobs are created through an entrepreneurial initiative funded by the Tooth Fairy, the Easter Bunny, and Father Christmas. And, the Stork, it seems, delivers jobs to grateful job seekers. Do I exaggerate? Do I misinterpret? What else can be inferred from the chaotic, quixotic, frenetic stream of proposals, legislation, and public programs aiming to produce jobs which have appeared in most states? If hope, good will, and hard work were good enough, these economic development schemes would be successful. But, for the most part, these schemes neglect the tough economic facts and ways of life. Yes, you can say you heard it from me: The fairies will not get you a job.

Most of the recent schemes for creating jobs have a decidedly regional flavor. Just as marketers have discovered that a local "angle" can sell products in saturated markets (Edmondson, 1987), politicians similarly have begun to capitalize on regional pride, tradition, and strength to squeeze economic growth and change from a region (Russell, 1987). For instance, the Reagan administration has proposed adapting British ideas for business enterprise zones to solve urban employment problems (see summary by Office of Community Planning and Development, 1985). The supply-side economic assumption behind

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enterprise zones is that reduction of tax and regulatory burden in designated urban areas will release powerful pent–up forces of private entrepreneurship, which, in turn, will increase urban employment opportunities (Gunther & Leathers, 1987). Yet, the supply–side assertion that good follows relaxation of government burdens is based alone on hopes about what entrepreneurs will do with the saving they realize. The number, kind, and quality of jobs that could be created through enterprise zones remain unclear, as are the opportunity costs and trade–offs of tax and regulatory reduction. Moreover, regional economic health cannot be guaranteed without a healthy national economy. As Slater (1987) demonstrates, regional economic development, especially in stagnating regions, depends upon at least 3%–4% annual growth in gross national product.

My home state, Pennsylvania, has established an economic development initiative, called the Ben Franklin Partnership Fund, "to maintain and create jobs in new technology enterprises" (Board of the Ben Franklin Partnership Fund, 1986, p.2). The Fund responds to the same economic needs as well as perceived strengths and opportunities that motivate many similar programs throughout the regions of the United States (see, e.g., Srully, 1986; Turner, 1987; Wellborn & Klose, 1986). The Ben Franklin Partnership Fund promotes public–private collaboration in research and development, education and training, and entrepreneurial development, with emphasis on small firms, on applied research and development, and on links between the private sector and higher education (see Ahlbrandt & Weaver, 1987). The scope and quality of the Funds awards in research, development, education, and training are impressive (see, e.g., Advanced Technology Center of Central and Northern Pennsylvania, n.d.), and the Fund has established a link between advanced technology development and future stable employment for Pennsylvanians that appears, at first viewing, sensible.

Many questions remain unanswered, though, about the appropriateness of the Ben Franklin Partnership Fund's investments. For example, what is the net number of jobs that will be generated through these investments? In what industries and occupations? Are "advanced technologies" and "small businesses" the most promising seeds, indeed, for Pennsylvania economic growth? How much and what kind of education and training is needed subsequently to supply the labor to the developed industries? Moreover, if the targeted growth occurs, then what are the implications for human resources in industries that produce or purchase goods and services from the targeted industries? And, perhaps most importantly, could the same ends be accomplished through some other policy instrument such as revision of the Pennsylvania tax code or inter-regional or foreign export development?

The kernel of the problem facing regional economic development for employment is essentially a planning question: What are the employment implications of various development strategies? Answers to this question help to answer whether any development scheme is consistent and possible. Moreover, answers to this question are necessary before education and training services can be specified to support any regional economic development plan. This paper focuses on description and use of an economic model, interindustry analysis, that can provide an answer to this question. In particular, interindustry

analysis allows the many production, purchasing, and consumption dependencies and relationships in a regional economy to be portrayed simply. Potential changes in policy instruments can be examined – such changes as increased in inter-regional exports, increased construction of public housing or highways, or exogenous reductions in federal spending that affect a region. The interindustry model allows the employment effects of these changes to be estimated by industry and occupation. As a consequence, interindustry analysis provides an important planning tool to determine the human resource implications of any policy or practice that is meant to grow and develop a regional economy.

The remainder of this paper is divided into four sections. The subsequent section provides a framework for strategic planning of human resources for regional economic development. Then, the model for interindustry analysis is described. Next, I show the application of the interindustry model to a hypothetical economy. The last section of the paper contains an outline of some of the opportunities and issues that, I believe, persist in strategic planning of employment and training for regional economic development.

STRATEGIC PLANNING

Change demands adaptation; without change...
evolution would cease.

– Jonas Salk

As time passes, all things are moved, transformed, or substituted, one for another. Change, not stability, is a natural, fundamental condition of life. Change may result from an opportunity seized or from reaction to some external force. Whether change results from either a push or a pull, survival depends on the ability to adapt to change. So it is with plants and animals. And, so it is with human society.

Adaptation of plants and animals to change is, however, quite different from adaptation of humans. Humans, unlike animals, are, to a great extent, their own creations. Consider: Odysseus, Homers mythic wanderer, would appear an absolute stranger to us today – his old, faithful dog, Argos, would not – because the growth of human nature is continuous and cumulative. A uniquely human feature, not shared with plants, animals, or rocks, is that humans establish the course of this growth. We are what we have become through our dreams, our plans.

The word, *plan*, derives partly from a Latin word meaning *level ground*. Planning is, metaphorically, an attempt to stay of level ground and to avoid chaos resulting from failure to adapt to needs and opportunities posed by change. The overarching question in *strategic* planning is: What is to be accomplished? In contrast, *tactical* planning addresses how to accomplish it.

Many analysts diagnose the ills of modern organizations as the result of overemphasis on tactics; "on day–to–day operations....Concentration on short–term goals...that [emphasize] short–term results" (Wortman, 1982). Current interest in strategic planning in organizations is a reaction to this overemphasis (cf. Bresser & Bishop, 1983, Leontiades & Tezel, 1980, McKelvey & Aldrich, 1983, Passmore, 1987, pp. 2324, Quinn, 1980, and Shrader, Taylor, & Dalton, 1984, for information about the use and effects of strategic planning). Such professional journals as *Strategic Management Journal* and *Journal of Business Strategy* are almost solely devoted to publishing scholarly work about strategic planning. The book market is flooded with offerings about strategic planning (the 40 entries in the bibliography assembled by Geroy & Passmore, 1988, are only a sample). The public sector has followed the lead of the private sector in the use of strategic planning to manage change (a special issue of the *Journal of the American Planning Association* [1987,53(1)] is devoted to strategic planning in the public sector).

My notion of strategic planning is adapted from Byers (1987). Although most work on strategic planning refers to corporate business planning, the same concepts are adaptable, I believe, to any form of organization, such as a regional planning organization. A *strategy* is a pattern of objectives, purposes, or goals that are accompanied by the major policies and plans for achieving these ends. *Strategic planning* is concerned with making decisions about an organizations philosophy and mission, establishing objectives, and selecting the strategy that is to be used to achieve the organizations objectives. I assert in the introduction to this paper that much regional economic development activity is neither well–planned nor is it viewed strategically. My aim in the remaining sections of this paper is to provide methods for infusing strategic thinking into consideration of human resources to support regional economic development plans.

The consistency and possibility of objectives and strategies of any plan depend upon the ability to marshall resources implied by the plan. Human resources are perhaps the most important resources for any strategy. Specifically, the proper quantity and quality of labor must be provided to produce the goods or services specified in any plan for regional economic development. Therefore, successful strategic planning requires a detailed understanding of the supply and demand for labor required to implement the plan.

I treat the problem of estimating the supply of labor in several other papers (Marron & Passmore, 1979, Passmore, 1979a, Passmore, Marron, Mohamed, & Norton, 1983). The focus in the current paper is on estimating the demand for labor that is implied by a regional development plan. The next section of this paper contains a description of an economic model that creates these estimates.

INTERINDUSTRY ECONOMICS

The issue that confronts top management is not that of how to choose between unrestricted competition and all–pervasive planning, but rather of how to choose an effective combination of the two.

– Wassily Leontief, Harvard Business Review, 1964

Wassily Leontief received the Nobel Prize in economics for his work on interindustry economic analysis. Leontief's model can be used to, among other things, identify the employment, by industry and occupation, that is required to fulfill particular patterns of growth or change in an economy. In this section I, first, describe the origins of the interindustry model. Second, I outline the mathematics of Leontief's model. Third, I extend Leontief's economic model to the estimation of total employment by industry and occupation. This extension is due primarily to the work of Roger Bezdek and his colleagues which originally began at the Center for Advanced Computation at the University of Illinois. This section on interindustry economics is but a prelude to the next major section of this paper in which I apply Leontiefs model and its extensions to growth and change in a hypothetical economy.

Origins

Money flows. Each dollar paid to the baker for a cake is spent, in turn, for sugar, whipped cream, and flour. The mill where the baker buys flour uses the baker's money to buy grain. The farmer grew the grain from seed, fertilizer, and fuel purchased from suppliers. The diesel fuel supplied to the farmer completed a long journey from, perhaps, below nomadic sands to refineries to supertankers to distribution points. Banks, insurers, and other services support these transactions. Wages paid to workers at all stages of these complex transactions are used to purchase other goods and services for household consumption. So, the baker's cake sets up a complex flow of money through the economy. Many industries and workers are affected by the ripple made by even the most modest transaction. Add ripple to ripple, and you have a wave.

Early economists noticed these economic "waves". In 1758, for example, Francois Quesnay published his *Tableau Economique*, a tabular display stressing the interdependence among economic activities. Quesnay was the leader of a group of 18th century economists who became known as

physiocrats. They believed in the existence of a natural order in economic activity and regarded the state's role simply to preserve property and uphold the natural order. Quesnay's original *Tableau* depicted the interdependencies among activities in the operation of a single establishment – a farm. Later, Quesnay published a modified version of the *Tableau* to represent the entire economy of his day in the form of a series of circular money flows.

Quesnay's ideas remained dormant until 1874 when Leon Walras, considered the founder of mathematical economics, published *Elements d'economie politique pure*. Walras's analysis showed the interdependence among producing sectors of the economy and the competing demands of each sector for factors of production (land, capital, labor). Walras's ideas remained at the theoretical level because he felt that, even if the data were available to implement his model, the computational problems posed by testing his ideas with actual data would be formidable, if not insurmountable.

In the 1930's, Wassily Leontief employed an approach, similar to those presented by Quesnay and Walras, based on observations about economic interdependence in production. However, Leontief went beyond the theoretical analyses of Walras and Quesnay by publishing a table showing the transactions between producing and purchasing industries in the United States economy. Moreover, he provided mathematical tools, requiring no more than an understanding of ordinary algebra, necessary to derive some astoundingly useful information from the transaction table. Leontief's method is called *interindustry analysis* because it portrays dependencies among industries. Sometimes Leontief's model is called *input–output analysis* because it shows the inputs necessary from various industries to produce a unit of output in any industry.

Leontief (1936) first submitted his ideas in the *Review of Economics and Statistics*, and his subsequent articles in scholarly journals contained expansions and clarifications of these ideas. Leontief integrated his ideas into a number of books (central works include: Leontief, 1941, 1951, 1953, 1966). For a comprehensive list of contributions to interindustry analysis through 1963, bibliographies by Taskier (1961, 1964) should be consulted. The research output pertaining to interindustry analysis has become so large that the official bibliographic reference of the American Economic Association, *The Journal of Economic Literature*, has assigned a special section to input–output analysis. Brief, nontechnical descriptions of interindustry analysis are available from Elliott–Jones (1971) and Miernyk (1957, 1965).

Interindustry transaction tables are available for approximately 80 national economies. Although the Japanese probably are the most sophisticated users of Leontiefs models, interindustry analysis is used routinely in highly developed countries – both those that engage in central planning (cf, e.g., an annotated bibliography of Soviet interindustry analysis by Treml, 1973) and those that rely chiefly on market mechanisms for the allocation of resources and for the distribution of income (cf, e.g., a discussion of France's use of interindustry analysis by Cazes, 1972). The United States Bureau of Labor Statistics

applies Leontief's model to forecast economic and employment changes (Bureau of Labor Statistics, 1986).

Less developed countries use interindustry analysis to guide investments for development (Economic Commission for Latin America, 1956). Hawlings (1985) described the application of input – output methods to regional economies. Borque and Hanson (1967) and Giarratani (1976) have compiled extensive bibliographies of regional and interregional interindustry analyses in the United States. Additional citations to uses of interindustry analysis, with special reference to human resource planning, are found in Passmore (1979b) and Passmore and Frisina (1979).

Model

Economic Order

The economy can be divided into sectors called *industries*. An industry is composed of firms producing a similar product. Industries do not form a natural taxonomy. Therefore, a classification scheme must be introduced. But, an indeterminable number of classification systems could be used. In the United States, industry sectors typically are classified according to the industrial classification system used in the United States Census of the Population and Housing (see Bureau of the Census, 1981).

Some interindustry models use a small number of sectors, rendering a highly aggregated – and, therefore, highly simplified – picture of the economy. Other interindustry models classify sectors in fine detail to allow analysts to focus on relatively small areas of economic activity. The basic notion in interindustry analysis is that each industry combines a set of inputs (land, capital, labor) in fixed proportions to produce its output, which, then , is sold to other industries to meet their own input requirements.

What stimulates industries to produce certain amounts and kinds of output? The *raison d'etre* for economic organization, as a basic form of human organization, is to meet the material needs of society. The Gross National Product (GNP) of a country, which I also refer to as *final demand* in this paper, is the value of goods and services produced in a nation during a certain period of time (commonly a year). The components of GNP – personal income expenditures, investments, net exports, government expenditures – can be thought to represent an order for production presented to industries by society. The level and kind of demands for goods and services cause industries to produce certain outputs and, as a consequence, create demands by these industries for the output of other industries. So, like a finely tuned machine or (depending on your sense of the importance of the goods and services produced) a

Rube Goldberg device, industrial activity and the employment it creates are driven by the material demands of society.

Transactions

Consider an economy with n industries, in which there are I producing industries and J purchasing industries ($I = J = n$). Let **X** define a square n–by–n matrix with elements x_{ij} denoting the dollar value of output of producing industry i purchased by industry j. For example, the steel industry sells some of its output to the automobile industry. Diagonal elements of **X** contain the amount of output of industry i that it purchases to produce its own output. For instance, the steel industry uses some of its own output. **X** is called an *interindustry transaction matrix* that describes the processing sector of an economy.

Final Demand

GNP, or final demand for goods and service in the economy, contains p expenditures categorized within such major expenditure categories as personal income expenditures, investments, net exports, government expenditures. Let **G** indicate an n–by–p matrix with elements g_{ip} denoting the dollar value of industry i output that does not pass to other purchasing industries in the processing sector of the economy, but goes directly to GNP category p. **G** is important because it reveals the material priorities of a society. Growth and change in the economy are manifest in changes in **G**. The sum of the rows of **G** is denoted as **y**, an n–length vector containing the dollar value of output from each of the i producing industries that goes to meet total final demand for goods and services. The sum of **y** is the total GNP of the economy.

Total Output

Let **x** indicate an n–length vector with elements x_i denoting the total output of industry i. Total output is the sum of the producing industry's output sold to purchasing industries plus the producing industry's output that goes directly to meet final demand for personal consumption expenditures, investments, exports, and government expenditures, or in matrix terms:

$$\mathbf{X} + \mathbf{y} = \mathbf{x}. \qquad (1)$$

Technical Coefficients

The amount of output purchase by industry *j* from producing industry *i* is shown in **X**. The proportion of industry *j* contribution to industry *i* output, a_{ij}, is computed from x_{ij}/x_i. Let **A** represent an *n*–by–*n* square matrix containing elements a_{ij} . Now, equation (1) can be rewritten as:

$$\mathbf{Ax} + \mathbf{y} = \mathbf{x}, \tag{2}$$

showing that the total output is the proportion of total industry output that is sold to other industries plus industry output that contributes to final demand. Elements of **A** often are called technical coefficients, input coefficients, or coefficients of production.

Assumptions

A – that is, the mix of inputs necessary to achieve a certain level of industry *i* output – is assumed to be fixed, homogeneous, and linear. In other words, the mix of inputs for industry *i* is not expected to change, the same mix of inputs is needed by all firms in industry *i*, and no economies or diseconomies of scale exist with changes in industry *i* output. Moreover, it is assumed that there is zero elasticity of substitution between industry *i* inputs. This means that changes in the prices of industry *i* inputs do not lead to changes in the proportion of inputs from producing industries purchased by industry *i*. These assumptions cause the input–output model I consider in this paper to represent a static, open economic system. The assumptions may be relaxed to cast a more realistic model of a dynamic, closed economic system, but the resulting model would be more complex than I want to present in this paper.

Technical coefficients are assumed to be fixed over the interval the interindustry model is expected to portray. In actual transaction matrices, most technical coefficients are relatively stable. Changes in technical coefficients would reflect fundamental changes in the technology of production. However, coefficients that change rapidly, cause severe shocks in the economy. For example, the oil crisis of the 1970's required alterations in the energy inputs in many industries. There was frantic scurrying about to find other sources of oil and to develop alternate energy sources. The "energy problem" was manifest in changes in technical coefficients that resulted in bottlenecks in producing and purchasing industries, with consequent restrictions in income, employment, consumption, and total production.

Leontief Inverse

The question is: How much total output must be produced by the processing sector of the economy to meet final demand? Rearrangement of equation (2) to state interindustry transactions and total output in terms of final demand yields:

$$\mathbf{x} - \mathbf{Ax} = \mathbf{y}. \tag{3}$$

Introduction of **I** an *n*–by–*n* identity matrix (a matrix with 1's on the diagonal and 0's in off–diagonal elements) allows equation (3) to be arranged:

$$(\mathbf{I} - \mathbf{A})\mathbf{x} = \mathbf{y}$$

and, then, solved for **x** through:

$$(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} = \mathbf{x}, \tag{4}$$

where $(\mathbf{I} - \mathbf{A})^{-1}$ is the inverse of the matrix formed by $(\mathbf{I} - \mathbf{A})$. This inverse often is called the *Leontief Inverse*, the elements of which indicate the output requirements generated directly or indirectly for industry *i* by industry *j* for every dollar's worth of industry *i* output delivered to final demand. Said in another way, the Leontief Inverse shows how much **x** must increase to increase **y** by one dollar. The Leontief Inverse is the central analytical tool in interindustry analysis.

Changes in Final Demand

Alterations in final demand takes several forms. First, GNP can increase uniformly over industries. Or, second, new priorities are evident when GNP is redistributed among the *n* industries and *p* expenditure categories. Real or proposed reorderings of GNP expenditures can be studied through a series of "what if" questions. For instance, what if the nation pursues a policy of disarmament and shifts defense funds to social programs? What if taxes are lowered? What if energy inputs to production are restricted? What if a region decides to provide tax relief to targeted industries? What if less federal revenue is shared with a region?

A new vector of final demand, $\mathbf{y}^*$, can be established to conform to altered priorities for final demand. Substitution of $\mathbf{y}^*$ into equation (4) yields a new total output vector, $\mathbf{x}^*$, which shows the total output necessary to create a different amount and kind of final demand. Premultiplication of $\mathbf{x}^*$ by **A** results in a new interindustry transaction table which shows the amount of interindustry transactions required to support the level and kind of final demand specified by $\mathbf{y}^*$.

Application of this technique requires translation of the policy under consideration into an explicit distribution of GNP. Examination of the new interindustry transaction table is required to determine whether the economy can actually support the kind and amount of change in GNP required. These methods have had broad application to a variety of practical problems. As an illustration, Leontief (1966, ch. 9 & 10) studied the economic effects of disarmament and the structure of American exports and imports (Leontief, 1966, ch 6) using these methods. This technique frequently is called *sensitivity analysis* because it allows study of the vulnerability of various aspects – employment, income – of an economy to variations in final demand. I will extend this method to the examination of how employment in an economy is affected by variations in final demand.

Extensions to Employment

Extensions of the interindustry model to account for total employment originally were made by Leontief ((1946). Bezdek (1971, 1974) developed techniques for distributing total employment by occupation within industries.

Labor Input

A mix of land, capital, and labor is used to produce an industry's output. Let Θ indicate an *n–by–n* diagonal matrix of labor input coefficients to production. Diagonal elements of Θ, Θ_{ii}, are calculated from e_i/x_i, where e_i is the total employment in industry *i*. Labor input coefficients define the number of workers needed to produce one dollars worth of total output. Total employment by industry is not calculated in the interindustry model; rather, it is derived from independent sources such as statistical surveys.

Employment by Occupation

Let **M** denote an *n*–by–*n* matrix containing elements m_{ij} which describe the number of workers required within industry *i* in order for industry *j* to deliver a dollar's worth of output to final demand. **M** is calculated by postmultiplying the labor input coefficients by the Leontief Inverse, or:

$$\mathbf{M} = \Theta\,(\mathbf{I} - \mathbf{A})^{-1}. \tag{5}$$

Total employment by industry, **MTOT**, can be derived by multiplying final demand by **M**, or

$$\mathbf{MTOT} = \mathbf{M}\,\mathbf{Y}, \tag{6}$$

where **Y** is an *n*–by–*n* diagonal matrix formed by putting elements of the final demand vector, **y**, on the diagonal. **MTOT** shows the total employment directly and indirectly created by a particular pattern of final demand.

An economy contains *k* occupations. Employment within producing industries by occupation is displayed in matrix **S**, an *n*–by–*k* matrix, with elements s_{ik}, calculated from:

$$\mathbf{S} = \mathbf{RB}, \tag{7}$$

where **R** is an *n*–by–*n* diagonal matrix with the row sums of **MTOT** on its diagonal elements and **B** is an *n*–by–*k* matrix showing the percent distribution of employment in industry *i* and occupation *k*. Rows of **B** are known as the *occupational staffing pattern* for industry *i*. **B** is not calculated in the interindustry model; rather, it usually is determined through occupational employment surveys within industries (see Scoville, 1969, for a thorough discussion and analysis of the inadequacies of several major occupational classification systems that still persist in the late 1980's). **S** is the employment by industry and occupation that is required to produce a particular distribution of GNP.

Several other policy–relevant results can be dissected from **S**, which shows the occupational employment generated *in* every industry. First, the occupational employment generated *by* each industry, shown in matrix **SB**, is calculated from:

$$\mathbf{SB} = \mathbf{MTOT}' \mathbf{B}, \tag{8}$$

where $\mathbf{MTOT}'$ is the transpose of **MTOT**. **SB**, then, shows how many workers in each occupation over all industries owe their jobs to a particular industry. Second, by letting **BK** denote an *n*–by–*n* diagonal matrix whose diagonal elements correspond to column *k* of **B**, *n*–by–*n* matrix **SC(k)** can be created, where:

$$\mathbf{SC(k)} = \mathbf{MTOT}' \mathbf{BK}. \qquad (9)$$

There are *k* **SC(k)** matrices that show how many workers in a particular occupation owe their jobs to each the output delivered by each industry to final demand. The **SC(k)** matrices are referred to as *occupational employment profiles*, and they contain a highly detailed description of the structure of demand for an individual occupation generated by a specified distribution of GNP.

Sensitivity of Employment to Fluctuations in Final Demand

The interindustry model and its extensions to employment estimation provide the tools to examine the sensitivity of employment by industry and occupation to fluctuations in the amount and kind of output delivered to final demand. A new vector of final demand, $\mathbf{y}^*$, can be established to conform to altered expenditure priorities. Substitution of $\mathbf{y}^*$ into equation (6) yields a new **MTOT** matrix which shows the new total employment required to produce a different amount and kind of final demand. Carrying through calculations through equations (7), (8), and (9) allow estimation of total employment by industry and occupation (matrix **S**), occupational employment that each industry generates (matrix **SB**), and employment generated in a particular occupation by interindustry contributions to final demand (**SC(k)** matrices).

I review elsewhere (Passmore, 1979b) studies that used interindustry analysis to examine the sensitivity of employment to actual or anticipated economic changes. Several summaries, though, may help the reader understand the usefulness of such studies for policy development and review:

- Bezdek and Hannon (1974) determined the energy and employment effects of reinvesting the $5 billion (in 1975 dollars) Highway Trust Fund in six alternative programs: railroad and mass transit construction; educational facilities construction; waste treatment plant construction; law enforcement; national health insurance; and tax relief. They found that energy consumption would be reduced by shifting the Highway Trust Fund to spending in all of these categories, except in the case of tax relief. Total employment would be increased in all cases, with varying effects on employment in particular occupations.

- Bezdek (1972) analyzed the employment effect of *Counterbudget* (Benson & Wolman, 1971), which was a broad plan presented by the National Urban Coalition for reordering national

expenditure patterns to emphasize social programs. Bezdek found that the *Counterbudget* proposal would not be feasible because it decreased employment in many occupations. Moreover, some occupations experiencing severe shortages of labor would require unrealistically large increases of workers to meet the pattern of final demand implied by the *Counterbudget* proposal.

Because the proof of the pudding is in its taste, I present in the next major section of this paper a demonstration of interindustry economics to simplified, hypothetical economic data.

TINKERLAND: AN APPLICATION

This is the shape of the leaf,
And this of the flower,
And this the pale bole of the tree
Which watches its bough
In a pool of unwavering water
In a land we shall never see.

— Conrad Aiken, This is the Shape of the Leaf, 1922

So that the previous section of this paper becomes more than an collection of abstract accounting equations, I cast a hypothetical regional economy in the interindustry economic framework in this section. First, I describe production, consumption, and employment in the economy . Second, the status quo of the economy is altered in many ways to determine the effects of reordering priorities for final demand on occupational employment in each industry.

Status Quo

Transactions

Welcome to Tinkerland!

According to brochures prepared by the *Tinkerland* Area Development Authority, the regional *Tinkerland* economy contains five industries: mining; manufacturing; construction; business and repair services; and transportation. Workers are employed in six major groups of occupations based on the United States census occupational classification system (Bureau of the Census,1981): managerial and professional specialty occupations; technical, sales, and administrative support occupations; farming, forestry, and fishing occupations; precision production, craft, and repair occupations; and operators, fabricators, and laborers. There are six destinations for final demand for goods and services produced by the five industries: households; state government; defense expenditures by the federal government; non-defense expenditures by the federal government; inter-regional exports; and foreign exports.

Transactions among Tinkerland producing and purchasing industries shown in Table 1 correspond to matrix **X** in the "Interindustry Economics" section of this paper. The distribution of final demand over industries is matrix **G**. Total final demand is vector **y**, and total output is **x**. The total output of the *Tinkerland* economy during 1986 was $500 million. Its gross regional product, the value of goods and services delivered to meet final demand in 1986, was $202 million. Therefore, *Tinkerland* actually produced more than two times its gross regional product. Households received 40.1% of *Tinkerland's* gross regional product. Eleven and nine-tenths percent went to state government, 5.4% to federal defense expenditures, 13.9% to federal non-defense expenditures, 21.3% to inter-regional exports, and 7.4% to foreign exports.

Interindustry transactions in the processing sector of Table 1 show, for example, that mining sold $9 million worth of goods and services to construction; mining purchased $21 million of its own output. Mining was the largest contributor to *Tinkerland* gross regional product, accounting for $67 million of the $202 million (33.2%) that went to final demand. Also, mining has the highest percentage (67%) of its total output that went to final demand among all five *Tinkerland* industries.

The matrix of technical coefficients, **A**, for the *Tinkerland* economy, derived by dividing the total output of each producing industry into the amount purchased by other industries (including itself), is:

$$\mathbf{A} = \begin{bmatrix} .21 & 0 & .09 & .03 & 0 \\ .01 & .08 & .07 & .29 & 0 \\ .03 & .20 & 0 & .50 & .07 \\ .31 & .02 & .38 & 0 & .03 \\ .10 & .25 & .26 & .01 & .04 \end{bmatrix}.$$

The Leontief Inverse for the *Tinkerland* economy is computed by taking the inverse of

Table 1
Tinkerland Regional Input, Demand, and Output in 1986 (Producer's Prices, $ Millions)

	Purchasing Industry					Final Demand							
								Federal					
Producing Industry	Mining	Manufacturing	Construction	Business & Repair	Transport	Households	State	Defense	Non-Defense	Inter-Regional Exports	Foreign Exports	Total Final Demand	Total Output
Mining	21	0	9	3	0	30	10	5	0	20	2	67	100
Manufacturing	1	8	7	29	0	25	5	2	0	15	8	55	100
Construction	3	20	0	50	7	5	1	4	4	3	3	20	100
Business & Repair	31	2	38	0	3	12	2	0	11	1	0	26	100
Transport	10	25	26	1	4	9	6	0	13	4	2	34	100

Source: Adapted from Hawlings (1985, Figure 3.2, p.25).

$$(I - A) = \begin{bmatrix} .79 & 0 & -.09 & -.03 & 0 \\ -.01 & .92 & -.07 & -.29 & 0 \\ -.03 & -.20 & 1.00 & -.50 & -.07 \\ -.31 & -.02 & -.38 & 1.00 & -.03 \\ -.10 & -.25 & -.26 & -.01 & .96 \end{bmatrix},$$

which yields

$$(I - A)^{-1} = \begin{bmatrix} 1.33 & .05 & .18 & .15 & .02 \\ .23 & 1.17 & .30 & .50 & .04 \\ .40 & .36 & 1.41 & .82 & .13 \\ .58 & .19 & .61 & 1.38 & .09 \\ .31 & .41 & .48 & .38 & 1.09 \end{bmatrix}.$$

$(I - A)^{-1}$ shows the dollar amount that had to be transacted between industries to deliver an additional dollar's worth of output to *Tinkerland* final demand (Note: numbers in the Leontief Inverse have been rounded for presentation in this paper; however, double precision arithmetic was used in the actual calculations).

How are elements in the Leontief Inverse for the 1986 *Tinkerland* economy interpreted? This inverse contains the output requirements generated directly or indirectly for industry *i* by industry *j* for every dollar's worth of industry *i* to final demand. In terms of the *Tinkerland* inverse, this means that, for example, mining had to produce $1.33 worth of output for itself for every $1.00 it delivered to final demand. For every $1.00 of manufacturing output going to final demand, manufacturing had to deliver 23¢ of its output to mining. For every $1.00 of construction output delivered to final demand for construction goods and services, construction had to produce 82¢worth of output for business and repair services.

The Leontief Inverse displays the dependencies that existed in 1986 between industries in the *Tinkerland* economy as they interacted to fulfill the demand for goods and services delivered to categories of final demand. The implications are that more output is needed from all other industries if mining goods and services are in greater demand (perhaps more mining output is exported). Mining purchases goods and services from other industries, either directly or after they are processed by other industries, to produce its output. The web of interdependencies in an actual economy is especially gnarled because there are many more industries and categories of final demand than in *Tinkerland*. An economy is like a big ball of tangled string – pull a loose end on one side, and another end wiggles on the other side of the ball. The lesson: a change in any part of an economy usually has repercussions for other parts of the economy.

Labor Force

Tinkerland had 3 million people in its 1986 civilian, noninstitutionalized population between the ages of 16 and 70 years old. The 1986 labor force status of the *Tinkerland* population, according to standard labor force definitions (see Passmore, 1981, for a review of these definitions), was:

Labor Force Status	*n*	%
In the Labor Force (employed + unemployed)	2,200,000	73.3% of the population
Employed	1,900,000	63.3% of the population
Unemployed	300,000	13.6% of the population
Out of the Labor Force	800,000	26.7% of the population

People who are unemployed and out of the labor force represent a "reserve army" that could be enlisted to meet *Tinkerland's* needs for additional workers as a result of economic change, but, of course, some mismatch may exist between the human capital these people possess and any new labor needs in the regional economy.

Tinkerland industries vary in the amount of labor they need to produce a dollar's worth of output. Total output (matrix x in the section on "Interindustry Economics"), total employment, and labor input coefficients (diagonal elements of matrix Θ) during 1986 for *Tinkerland's* five industries were:

Industry	*Output (1)*	*Employment (2)*	*Labor Input (2 ÷ 1)*
Mining	$100,000,000	600,000	.006
Manufacturing	$100,000,000	400,000	.004
Construction	$100,000,000	300,000	.003
Business & Repair	$100,000,000	100,000	.001
Transport	$100,000,000	500,000	.005
Total	$500,000,000	*Total* 1,900,00	*Total* .019

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Employment by Occupation and Industry

The distribution of 1986 *Tinkerland* employment by industry and occupation is shown in panel I of Table 2 (produced by computing matrix **S** described in the section on "Interindustry Economics"). The pattern of employment was required to produce the amount and kind of final demand specified in Table 1. Occupational employment varied from a high in technical, sales, and administrative support occupations, in which approximately one–fourth of all workers were employed, to farming, forestry, and fishing occupations, which employed only one in every 20 *Tinkerland* workers. Mining, the reader will remember, contributed the greatest proportion of industrial output to total 1986 *Tinkerland* output; likewise, mining accounted for the most employment of any of the five industries. Business and repair services had the lowest number of workers in the *Tinkerland* economy during 1986.

The distribution of occupational employment within industries varied because industries required different mixes of skills to produce goods and services. For example, construction and business and repair service industries had a higher percentage of their total industrial employment employed in managerial and professional specialty occupations than did other industries. Operators, fabricators, and laborers were a greater proportion of the workforce in mining and manufacturing industries than in other industries. The interested reader can calculate the occupational staffing pattern of each industry by dividing the number employed within each occupation in an industry by its total employment.

The dependency of occupational employment on the the amount if total output of each industry is striking. Entries in panel II of Table 2 the number of jobs in each occupation that were generated *by* each industry (matrix **SB** in the section on "Interindustry Economics"). Comparison of panels I and II indicates that, for instance, although mining employed 120,000 people in managerial and professional specialty occupations (panel I), the industrial output of mining delivered to industries and to final demand generated jobs for 169,600 people in managerial and professional specialty occupations (panel II). In other words, mining generated employment for 49,600 more workers in managerial and professional specialty occupations than it employed. As another example from panel II, 16,500 workers in precision production, craft, and repair occupations over all industries owed their jobs to economic activity generated by the business and repair industry. In terms of the entire 1986 *Tinkerland* economy, mining was a big player – it employed 600,000 people, almost one–third of all *Tinkerland* workers. But, even more important is that mining production created jobs for 819,000 workers (sum over the mining row in panel II of Table 2) over all industries in the *Tinkerland* economy.

The following comparison of the employment generated *within* and *by* each industry isolates sectors of employment dependencies in the 1986 *Tinkerland* economy:

Table 2
Regional Occupational Employment Generated Within and By Tinkerland Industries in 1986

Producing Industry	Occupation (in thousands)					
	Managerial/ Professional Specialty	Technical/ Sales/ Administrative	Service	Farming/ Forestry/ Fishing	Precision/ Craft/ Repair	Operators/ Fabricators/ Laborers
			I. Generated Within Industries[a]			
Mining	120	120	60	30	90	180
Manufacturing	40	120	80	10	300	120
Construction	90	90	30	22.5	30	37.5
Business & Repair	30	20	10	10	5	25
Transport	100	150	100	40	10	100
Total	380	500	280	112.5	165	462.5
%	20.0%	26.3%	14.7%	6%	8.7%	24.3%
			II. Generated By Industries[b]			
Mining	169.6	188.2	98.4	46.5	96.9	219.4
Manufacturing	72.3	134.1	82.7	21.7	30.4	114.7
Construction	45.5	53.9	26.4	13.1	15.1	37.1
Business & Repair	49.6	61.3	32.5	14.8	16.5	49.2
Transport	43	62.5	40	16.4	.61	42.1
Total	380	500	280	112.5	165	462.5
%	20.0%	26.3%	14.7%	6%	8.7%	24.3%

[a]Matrix **S** from section on "Interindustry Economics."

[b]Matrix **SB** from section on "Interindustry Economics."

Employment Generated (in thousands)

Industry		*Within (1)*		*By (2)*		*2 ÷ 1*
Mining		600		819.0		1.37
Manufacturing		400		455.9		1.14
Construction		300		191.1		.64
Business & Repair		100		223.9		2.24
Transport		500		210.1		.42
	Total	1,900	*Total*	1,900	*Total*	1.00

For approximately every 3 workers employed in mining, need was generated for at least one other worker in the 1986 *Tinkerland* economy. A remarkable finding is that business and repair service industries employed the lowest number of workers in the *Tinkerland* economy, but more than two workers in all industries were required to support the output of every worker in the business and repair service industries.

Based upon this analysis, it is clear that mining, manufacturing, and, especially, business and repair service industries created jobs outside their own industries. Obversely, the total industrial outputs of transportation and construction industries could only directly support the employment of approximately one of every two construction workers, and total employment in these industries, therefore, depended heavily upon the activity of the three other *Tinkerland* industries.

The dependence of employment in any single *Tinkerland* occupation on interindustry transactions can be demonstrated. For example, the interindustry pattern of employment for service occupations keyed to interindustry activity (matrix **SC(k)**, where *k* is service occupations "Interindustry Economics") was:

$$\mathbf{SC(service)} = \begin{bmatrix} 5{,}358 & 1{,}214 & 796 & 386 & 2{,}084 \\ 158 & 5{,}163 & 592 & 103 & 2{,}254 \\ 220 & 483 & 843 & 122 & 969 \\ 227 & 1036 & 639 & 358 & 992 \\ 37 & 102 & 131 & 30 & 3{,}703 \end{bmatrix}.$$

The rows of matrix **SC(service)** are producing industries, and the columns are purchasing industries. Over one-half of employment in service occupations was generated solely from the production of mining, manufacturing, and transportation goods and services for these industries' own consumption [{(5,358 + 5,163 + 3,703) ÷ 28,000} x 100]. Transportation's sales to mining (row 5, column 1) and to business and repair services (row 5, column 4) created less than 1% of all employment in service occupations [{(37 + 30) ÷ 28,000} x 100]. Mining's sales to transportation (row 1, column 5) and manufacturing's sales to transportation (row 2, column 5) accounted for about 15% of all service occupation employment [{(2,084 + 2,254) ÷ 28,000} x 100]. Other *Tinkerland* occupations exhibit dependencies on interindustry transactions that can be revealed through similar matrices.

Results of descriptive interindustry analysis of the *Tinkerland* economy have value for strategic planning of employment and training. On the employment side, information in Tables 1 and 2 clearly links production, consumption, and employment in *Tinkerland*. In particular, panel II of Table 2 highlights industrial sectors from which investments in growth and development might yield a high return of jobs. On the training side, information in panel I of Table 2 shows the demand for occupations to which training institutions supply labor. Panel II of Table 2 shows how increases in industries, seemingly unrelated to target industries of the training institutions, an affect the demand for occupations to which training institutions supply labor. My colleagues and I have offered elsewhere reports of uses of descriptive results of interindustry analysis to plan education for work (see, e.g.: Passmore, 1979a, Passmore & Marron, 1978, Passmore & Marron, 1982, Passmore, Marron, Hamil, & Fowler, 1979, Passmore, Marron, Norton, & Mohamed, 1983, Passmore & Martin, 1977). The next frontier, though, is to use the results of interindustry analysis to determine the sensitivity of occupational employment by industry to planned or anticipated changes in the economy.

Changes

What if...what if...what if? What would happen to the amount of occupational employment by industry if *Tinkerland's* priorities for final demand changed? The effects of four *Tinkerland* scenarios are considered. First, I estimate the employment effects of relocation of a major manufacturing concern into *Tinkerland*. Second, infusion of government revenues for improvements in *Tinkerland's* infrastructure is studied. Third, shifts in federal spending from defense to non-defense expenditures in the Tinkerland economy are considered. Fourth, I simulate the employment effects of *Tinkerland's* involvement in a high technology adventure similar to that required to implement the federal governments plans for the Strategic Defense Initiative.

Each of the scenarios involves changes in the amount and distribution of final demand in the *Tinkerland* economy. The details of the changes are discussed below, but each scenario calls for some overall economic growth as well as change. In making these changes, I am, indeed, merely tinkering with the *Tinkerland* economy much in the same way an amateur would fool with the works of a clock. Forecasting of changes in final demand in actual economies is a science, art, and business all rolled into one (consult, e.g., Wharton Econometric Forecasting Associates, 1982).

Other factors could affect *Tinkerland* employment, but they are not examined in this paper. For instance, total employment and the amount and distribution of employment over industries are affected by changes in labor input coefficients (diagonal elements of matrix Θ), which would reflect changes in the productivity of labor in industries. Changes in the occupational staffing pattern within industries (changes in the percent distribution of occupational employment in industries) probably would go hand-in-hand with changes in industrial productivity. Various occupations would need relatively more or fewer workers if technology changed within an industry. Or, perhaps change in technology might create a new occupation and make redundant an existing occupation. Also, fundamental changes in interindustry transactions, manifest in changes in matrix **A**, could occur from changes in the production functions of industries, resulting in changes in economic structure and patterns of employment.

Bansal!

A Japanese toy manufacturer is evaluating whether one if its plants should be relocated during 1989 to some fallow, inexpensive *Tinkerland* airport hanger space. If this relocation occurs, the contribution of manufacturing to final demand for manufacturing goods and services will increase by 20%. Some of the increased manufacturing output would be purchased by local households from a factory outlet. However, most of the toys made by the new plant would be exported to other regions and to foreign markets. Another factor to consider is that *Tinkerland* gross regional product is expected to experience real growth of 7% between 1987 and 1989, one-third of which will be due to increased demand for household construction. This natural growth and change in *Tinkerland* is expected to add 188,193 jobs (based on interindustry analysis that I do not tabulate in this paper). Increase in manufacturing output due to the potential relocation is added on top of this 7% growth.

The occupational employment implications of the toy factory relocation for *Tinkerland* are displayed in panel I of Table 3, which shows only the net effect of the change required by this scenario; the effects of natural growth and change have been removed so that the effects of factory relocation can be isolated. The relocation of the toy manufacturing facility would add 95,327 jobs. Occupations within manufacturing industries would reap the greatest share of this increase, although jobs would be created in varying numbers in all *Tinkerland* industries and occupations.

Table 3
Changes in Status Quo Occupational Employment by Industry for Four Tinkerland Economic Scenarios

Producing Industry	Employment Change from Status Quo (Net of Natural Growth and Change)[a]					
	Managerial/ Professional Specialty	Technical/ Sales/ Administrative	Farming/ Forestry/ Service	Precision/ Craft/ Fishing	Operators/ Fabricators/ Repair	Laborers
			I. Banzai!			
Mining	622	622	331	166	497	922
Manufacturing	5,406	16,218	10,812	1,352	4,055	16,218
Construction	3,712	3,712	1,237	929	1,237	1,547
Business & Repair	645	430	215	215	107	538
Transport	4,716	7,075	4,716	1,887	472	4,716
Total	15,101	28,057	17,311	4,549	6,368	23,941
			II. Boondoggle			
Mining	4,621	4,621	2,310	1,154	3,465	6,930
Manufacturing	2,535	7,602	5,068	634	1,901	7,602
Construction	26,564	26,564	8,854	6,641	8,854	11,068
Business & Repair	3,853	2,569	1,284	1,284	642	3,210
Transport	10,178	15,268	10,178	4,072	1,018	10,178
Total	47,751	56,624	27,694	13,785	15,880	38,988
			III. River of Butter			
Mining	444	444	222	111	333	665
Manufacturing	243	726	485	61	182	727
Construction	2,516	2,516	838	629	839	1,048
Business & Repair	367	245	122	122	61	305
Transport	970	1,456	970	389	97	970
Total	4,540	5,387	2,637	1,318	1,512	3,715
			IV. Star Wars			
Mining	2,654	2,654	1,327	664	1,990	3,979
Manufacturing	3,236	9,707	6,472	809	2,427	9,707
Construction	11,236	11,236	3,745	2,809	3,745	4,658
Business & Repair	6,231	4,154	2,077	2,077	1,039	5,193
Transport	5,934	8,902	5,934	2,374	594	5,844
Total	29,261	36,653	19,555	8,733	9,795	29,381

[a]Changes due to 7% redistributed growth were subtracted from change due to scenario.

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Can *Tinkerland* sustain the job growth implied by natural growth and change as well as the plant relocation? The answer to this question depends largely on the supply of labor in each occupation that is available to *Tinkerland* employers, a topic described encyclopedically by Sommers (1974). Perhaps some of the unemployed in the *Tinkerland* economy can fulfill the need for new workers; maybe some people who are out of the labor force can be stimulated to seek work. Or, perhaps some workers will migrate into the *Tinkerland* region because of the new work opportunities it affords. Whether the new workers will need training before they can be productive is an additional crucial planning factor for training institutions in the *Tinkerland* region (see Passmore, 1979a, Passmore, Marron, Hamil, & Fowler, 1979, Passmore, Marron, Norton, & Mohamed, 1983, and Passmore & Martin, 1977, for examples of use of occupational supply information in the planning of education and training).

Boondoggle

Senator Katchup believes strongly that *Tinkerland's* future depends upon refurbishing *Tinkerland* highways so that potential industrial investors can count on a sturdy infrastructure to transport their goods and services to markets. He succeeds in adding a rider to the Swamp Clearance Act of 1988 to pump $75 million, starting, in 1989 and spread over three years, into the *Tinkerland* economy for highway construction. The rider requires contracts for highway construction to be let only to established *Tinkerland* contractors. In a press conference, Katchup announces that, "This Bill will create construction jobs for many people in *Tinkerland*." How many and what kind? Certainly, non-defense federal expenditures will absorb the increased construction output. Without any special analysis, it is clear intuitively that Katchup's rider to the Swamp Act will add even more pressure to the construction sector of the *Tinkerland* economy than is likely to occur naturally.

Panel II of Table 3 contains the occupational employment implications of the Swamp Clearance Act of 1988 for the *Tinkerland* economy. Employment must increase by 200,722 workers to produce the industrial output implied by the Act. Occupational employment in the construction industry would shoulder 45% of the increase in the number employed, although, as in the previous scenario, all occupations and industries would require increased employment. So, the ripple effects of Senator Katchup's rider actually will yield more employment than he thought. And, again, the next question for *Tinkerland* planners to consider is whether the necessary labor can be supplied to meet the employment demands created by the rider to the Swamp Clearance Act of 1988.

River of Butter

Guns versus butter...It is the textbook economic trade-off. *Tinkerland* politicians have begun to noodle about whether a new United States President after the election of 1988 will create a change in

priorities for federal expenditures. Some politicians believe that the United States is heading for an administration that will spend more on butter, in the form of social programs, than on guns, in the form of defense expenditures. The Democrats in *Tinkerland* are optimistic that a veritable river of butter will flow, some of which eventually will trickle into the *Tinkerland* economy. Just what's in it for *Tinkerland*?

Tinkerland Democrats believe that 20% ($2 million) of amount of 1987 federal defense expenditures in *Tinkerland* will be reallocated. Simple reallocation of total defense expenditure to total non-defense expenditures would not, however, create any changes in total employment by industry or occupation because no changes in total output by industry would occur. Of course, much of the industrial output for defense (tanks, guns, etc.) does not have a (legal) domestic market. So, 90% of the 20% reallocated federal defense expenditures would be distributed to the federal non-defense category for purchase of construction of low-income housing. The remaining 10% would be redistributed to households in the form of tax relief.

Panel III of Table 3 shows the employment effects of the guns/butter trade-off envisioned by *Tinkerland* Democrats. The "river" envisioned by the politicians is a trickle, indeed – 19,109 new jobs would be created. Although this amount of increase is small compared with the previously considered scenarios, it may actually be a more sustainable increase when factors related to the supply of labor are weighed.

Star Wars

There is, certainly, a chance that the federal government may continue to purchase even more guns than butter if the Strategic Defense Initiative (popularly known as Star Wars) continues. *Tinkerland* defense contractors in manufacturing and business and repair industries will benefit from increased federal defense spending on Star Wars. What would the employment effects of 25% increase of federal government purchase of defense goods and services from *Tinkerland* manufacturing and business and repair services?

Panel IV of Table 3 shows the occupational employment by industry that would be required to support the increased federal defense expenditures in *Tinkerland*. An additional 133,378 workers would be needed to support Star Wars purchases in the *Tinkerland* economy. Over one-half of these increases will occur in construction and business and repair service industries, but substantial employment growth will occur in all industries and occupations.

ISSUES AND OPPORTUNITIES

We are neither overstretched nor are we spending too much on defense. Our problem is a loss of national will.

– Norman Podhoretz, *The New York Times Magazine*, 17 April 1988, p.67

Some readers might evaluate the focus on interindustry economics in this paper as a technical solution to what is essentially a nontechnical, moral, ideological problem in modern societies – that of providing fulfilling work and sufficient income for all citizens. Now, I do not propose use of interindustry analysis as a quick fix for regional economic and employment problems. Rather, I merely believe that many of the sincere hopes and vague plans offered for improving regional economies would be less vacuous if they were informed by their direct and indirect economic and employment consequences.

The methods I describe in this paper are within our technical capability, are simple to understand, and make the explicit connections – currently unfathomable, it seems, to many people – between what we produce, what we buy, and the jobs that are created through production and consumption. Strategic planning of education and training for regional economic development requires, first, knowledge of the amounts and kinds of labor needed to fulfill regional economic development plans (the topic of this paper) and, second, knowledge of how human capital can be supplied to meet the demand for labor that the plans would create. Decisions about training investment must be informed, then, by more than information about labor demand. Detailed information about sources of labor supply would help planners decide whether training actually is necessary to create the human capital needed.

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Some Perspectives on Passmore's Paper

Fred L. Otte
John H. Preston

David L. Passmore's paper, "Strategic Planning of Employment and Training for Regional Economic Development", is an interesting contribution to our thinking in this area for several reasons. It is based upon Wassily Leontief's work in interindustry economic analysis (p. 5) which is applied through the use of computer modeling. Also, it is a bit of tongue in cheek and deals with ". . . employment implications of various [ecomonic] development strategies."(p. 2)

The idea of illustrating Leontief's model through a computer model of a hypothetical economy adds interest to the subject because it allows for "tinkering" with the model and demonstrating the results. Such concrete examples aid understanding greatly and are a valuable service. One hopes that the hypothetical model can at some point be revised into a model that actually represents a particular geographical area so that it can be tested.

Examining how economic development strategies will affect employment while not neglecting ". . . the tough economic facts and ways of life" (p. 1) would seem to be of great interest to many people at first thought. But then one must ask, "Of interest to whom?" If economic development proposals come from politicians and businessmen, and if these groups are alert primarily to profit and public reaction, where is there a group with enough political power and enough concern for employment implications to use the results that could be produced by the application of such models as are suggested in this paper?

This line of thinking makes the paper puzzling. Toward the end of his section on strategic planning he says (p. 6) "I assert in the introduction to this paper that much regional economic development activity is neither well-planned . . . nor is it viewed strategically. My aim in the remaining sections of this paper is to provide methods for infusing strategic thinking into considerations of human resources to support regional economic development plans." If much development activity is so poor, why bother? Perhaps it is worth it for the few development programs that will seek a ". . . detailed understanding of the supply and demand for labor required to implement the plan," (p. 4) perhaps not. Passmore returns to this theme in the section on "Issues and Opportunities" (p. 27) when he says, "Some readers might evaluate the focus on interindustry economics in this paper as a technical solution to what is essentially a non-technical,

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moral, ideological problem in modern societies – that of providing fulfilling work and sufficient income for all citizens." After denying that as his purpose he then says, "Rather, I merely believe that many of the sincere hopes and vague plans offered for improving regional economies would be less vacuous if they were informed by their direct and indirect economic and employment consequences." A sense of puzzlement remains, however. Is reducing the "vacuous" nature of much current economic development planning what we are all about? How can we apply these concepts?

When one considers that the audience to whom the paper was addressed was primarily HRD professors from technical education departments of universitites, however, the usefulness of the paper can be seen. The paper points in a helpful direction for technical education planners seeking to estimate need for changes in vocational-technical preparation programs. More specifically, it suggests that ripple effects can be anticipated. Training for occupations related specifically to new developments that are being initiated will likely not be the only training needed. There will be secondary needs. Thus, the paper points the way to the need among educators for strategic thinking that relates technical education planning to economic development planning.

It also seems to have an application within an organization considering a geographical move and concerned about availability of human resources in the proposed new location. Strategic thinking regarding availability of human resources using such a model would obviously identify human resource needs that are distantly related to more immediate needs.

In short, the paper is interesting although a bit puzzling, but thought provoking to HRD professors in technical education departments. Perhaps an extension of this model might provide a means for analyzing regional or local training needs.

Tinkerland and Training and Development: Setting the Research Boundaries and Aims

Ronald L. Jacobs

Tinkerland is a hypothetical regional economy that Dave Passmore has invented to model the effects of inter-industry economics. Tinkerland has three million people with a total economic output of $500 million. The simulation shows how the various industrial categories (mining, manufacturing, construction, etc.) are interrelated and what happens to employment needs by industry when economic changes occur. The changing scenarios included the following: moving a Japanese toymaker into Tinkerland, funding a large highway construction public works project, reassigning 20% of present defense for low-cost housing and tax relief, or increasing federal defense expenditures by 25%. Following each scenario, occupational employment changes were projected. The bottom line that can be taken from the simulation is that if we change our economies, especially regional ones, then we must have some idea how these changes will affect various occupational employment needs.

Use of inter-industry economics provides an intriguing opportunity to understand the effects of our efforts to stimulate economic development. Dave mentions that this model is used by most government analysts to monitor employment trends and shifts. Undoubtedly, this modeling technique is also used here in my home state of Ohio, where economic development efforts have nurtured the emergence of many small to medium-sized companies. Given the importance of inter-industry economic analysis, however, the question remains about its relevance for doing research in training and development (T&D). In essence: Is this an appropriate area of concern for T&D researchers? My purpose here is to respond to this question, though I admit beforehand my comments my be as close to reality as that of the region of Tinkerland itself.

Simply put, my response to the question is an emphatic – yes! My view is based upon two assumptions: 1) the conceptual boundaries of T&D research must be continually expanded to include recent advances in theory and practice; 2) the aims of T&D research must be responsive to both corporate and societal needs. Let me discuss each of these assumptions in further detail. I know from firsthand experience that most attempts to define the boundaries of T&D research have led to some uncertain results. As chair of the Outstanding Student Research Committee of the National Society for Performance and Instruction, I have the frustrating task of describing the scope of topics acceptable for submission to

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the Society's annual student research award. Each year, the acceptable range of topics seems to grow more and more diverse.

What are the appropriate topics for T&D research? Should T&D research attempt to determine the best training methods and media? Or should T&D research help refine certain models and techniques useful for our specific practice settings? Or should T&D research respond to the immediate needs of a particular organization or industry sector? I would respond affirmatively to each of these queries, and more. To me, the boundaries of T&D research must be allowed to expand such that they will include all aspects of our present and projected areas of influence -- that is, all aspects of generating new knowledge about people and work. This broad-brush perspective includes research questions about the people doing the work, the work that must be performed, the best ways to transmit work information, the results of the efforts of people, and more.

My second point relates to the aims of T&D research. Until recently, most T&D researchers tended to focus on the needs of people who were already employed within an organizational setting. Fewer researchers addressed the needs of people preparing for new jobs or of those adapting to the loss of jobs. More recently, however, these general topics have been of interest to those researchers involved in the many joint education-government partnerships. In effect, these joint partnerships have helped redefine the aims of T&D research to include a broader societal focus. Recent T&D research studies have investigated such topics as the effectiveness of job search training for dislocated workers, the work-related problems of single-parent families, and the willingness of older workers to undergo retraining. These topics have clear societal implications.

Acceptance of an expanded perspective of T&D research inevitably allows some researchers, such as Dave Passmore, to pose questions at the strategic planning level. The effects of decisions made at the strategic level are felt by many, such as the individuals seeking employment in Tinkerland, but understood by few. Interest in strategic planning issues has increased substantially among T&D researchers and practitioners. Consider that ten years ago few T&D professionals were concerned about the broad economic issues related to people and work. Today, however, most T&D managers understand how their own departmental missions help support the missions of their organizations as a whole. For example, the training manager of a large regional bank told me that he has been directed to present a plan to address a projected problem for the late 1990's -- the decreasing literacy levels among many bank employees. His plan will include inviting local school administrators, some of whom represent elementary schools, to a series of focus-group meetings conducted by the bank's training staff.

My original question posed was whether the study of inter-industry economics was an appropriate subject of T&D research. My response to this is affirmative given an expansion of the conceptual boundaries of T&D research and a redefinition of the aims of T&D research. Just the same, studying the changing occupational patterns within a regional economy such as Tinkerland may generate little interest

among many T&D researchers. But who knows what research questions will be critical for our society and organizations in a few years? Could these include strategic planning from a T&D perspective? A few of my friends already think so. If they are correct, and I believe they are, then we must have the theoretical structures established to incorporate their findings. Interindustry economics is not for every T&D researcher; I'll admit it's not part of my research agenda. But taken from a broad perspective of T&D research, it works for me.

Coefficients for Strategic Planning: The Tinkerland Approach

Gary D. Geroy

Dave Passmore presents a model to explain and illustrate the interrelationship of industries in a hypothetical regional economy. The paper's premise is that by understanding interindustry economic modeling used by economic planners and decision makers, it is possible to extrapolate data critical to planning for human resources in an economy. In presenting this economy and enacting change simulations, he illustrates how these changes impact on the occupational needs profile in this economy. Simply viewed, the model is a tool for manipulating known factors associated with various industry production and processes. For example, using Passmore's model, if we create eight wheels and tires per day, we can equip two of our four automobiles we make per day for use on the road. Beyond that, our options are limited to waiting for an increase in production of tires, reduction in production of automobiles or redesign of automobiles to use two tires. The relationship of inputs to outputs becomes the technical coefficient.

Dave presents the applaudable concept that occupational employment can be viewed as a form of technical coefficient. Viewing economies as a complex interaction of commodity input and output of organizations is a common planning model for economists, but not for HRD practitioners or educators. The paper describes through models and data manipulation, how planners can use this modeling to become apprised of impacts on occupation labour supply and demand associated with the industries being studied. In my mind, two questions now emerge. First, should training and development practitioners care about use of such tools, become experts in their use, or should it remain in the domain of academic soothsayers? The second question is where, whether in the domain of either practitioners or theoreticians, does the research go from here?

My response to the first question follows the thrust of Dave's paper which is that decision maker's and planner's "hopes and vague plans offered for improving regional economies would be less vacuous if they were informed". Training and development practitioners who are not involved in strategic planning should acquire the skills and tools and get involved. The problem is that many practitioners come from a variety of backgrounds not related to training and which may or may not have the rigor that strategic planning for employment and training should have. The second part of this problem is that the powerful

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tool presented in this paper may need to be made simpler to use. The problem of simplifying the model may have to be addressed by the researchers and theoreticians.

The second question addresses what I perceive to be the next logical step in the further development of the model. In skills needs analysis research conducted at Penn State's Institute for Research in Training and Development, the concept of knowledge coefficients has emerged. Like the labor coefficient dealt with in Dave's paper, there appears to be a definable knowledge coefficient associated with each labour input/output factor. Beyond the work demanded to insure utility of the interindustry economic model to practitioners is a need to develop a second level analysis model. There is a need to create a model and process to link the occupational knowledge coefficients to each affected labor supply demand factor identified in the interindustry economic analysis output. It is then that the model presented in Passmore will have the greatest utility and impact at the educational and training practitioner level.

Passmore's approach is very much on target and provides a good approach to viewing HRD strategic planning issues. By viewing the ability of Passmore's model to describe the shifts in employment needs, we have a starting point for HRD analysis for strategic planning. The tool which Passmore provides will allow us to establish knowledge coefficients to drive training and education responses or changes in economics.

Is Leontief's Model Appropriate for Regional Planning?

Richard B. Armstrong, Jr.

Introduction

David L. Passmore's Strategic Planning of Employment and Training for Regional Economic Development presents an approach to strategic planning designed to identify potential labor force demands within a regional economic system using Wassily Leontief's interindustry input-output analysis model. The thesis of the Passmore position paper rests on the following assumption:

> The strategic planning of education and training for regional economic development requires, first, knowledge of the amounts and kinds of labor needed to fulfill regional economic development plans and, second, knowledge of how human capital can be supplied to meet the demand for labor that the plans would create. (Passmore, 1988, p. 37)

It is through Leontief's Model that these issues and knowledge needed for education manpower planning are proposed.

Leontief's Model

The input-output model developed by Wassily Leontief must first be understood in terms of its original assumptions and potential uses before one can effectively react to the implications of its use as a labor force development tool. In the input-output model, the economy is divided into a number of industries which consume the products of other industries and produce goods which are then consumed by other industries. One major assumption of the Leontief Model is that technical coefficients for the producing industries are assumed to be fixed. This implies constant returns to scale and denies substitution. (Balderston, 1954)

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The primary foundation of the model is that the input and output are considered commodities. That is the variables are assumed to be constant, ubiquitous to the production function, interchangeable in function within a broad classification, and generally uniform in characteristic. For example corn as an input or an output is predictable as always being corn. The same is also true with sugar. The theory assumes this quality exists among all inputs and outputs such as raw materials, capital, labor etc. Each individual input or output variable is identical to the one before as well as the one after it in the production function.

An examination of the suitability of the input-output system for labor force or human resource development purposes requires a statement of the following assumptions of the model:

1). that the economy consists of a set of "industries";

2). that each of these industries produces only one product;

3). that the production function of each industry is linear with fixed coefficients;

4). that the statistics collected for the input-output tables are appropriate for the calculation of the coefficients of the product;

5). that the coefficients of production of the year in which the table is constructed are good approximations for the actual coefficients of the year in question (Eckstein, 1954).

The above assumptions are potential sources of error in each application. Those under assumptions 1-3 are the assumptions of the theory. Assumption 4 raises questions of accuracy of data and of the theoretical concepts. Assumption 5 forces one to consider the quantitative significance of technological change in the economy.

Problems

Labor as Linear

The original model assumes labor to be a commodity. That all "labor" is reducible to a common unit of production input. There is no differentiation among divisions of labor and thus labor, as a unit is treated as interchangeable, as a function of input. Due to this assumption, labor as a function of production scale is considered linear and directly proportionate to the output demand curve.

However, in terms of empirical situations, labor by skill requirements is not a fixed commodity. Leontief's model was never intended to subdivide commodity units into their varying and respective components. Passmore assumes that the model can be used as a tool to identify selective subdivisions and skill requirements of labor.

Passmore's use of the model further assumes that labor is a linear function of production. This assumption is of minor consequence at the national level for such issues as full employment and employment projections. As the model is applied at the regional or local levels, the potential error resulting from the linear assumption increases. This potential error may result in invalidating the model. This potential exists because human capital at the site, local, and regional levels are non linear.

In addition, there are various external forces exerted at the regional level resulting in labor shifts. Such forces as organizational structure, organizational culture, changing technologies, and management choice must be considered. At the national level, these forces can be considered minor due to the population size.

The assumption of linearity in labor is also weakened when examining the scale of production function. While units of commodities are linear in nature to quantity produced, this characteristic does not apply to labor requirements. The threshold for labor is often much lower on a downward production trend and much higher on an upward production trend than other commodity units needed in the production function. This characteristic also varies with product types and technologies used in the production process. This non linear characteristic of labor is related to the skill mix demanded by a given industry and the labor supply of skilled human resources within a given labor pool.

Data Quality

The application of the Passmore approach to Leontief's Model for identifying labor characteristics presents another problem. Reliable data sources to serve as a sub-matrix of the labor row are not available. Currently available data sources for the identification of labor needs are secondary or proxies for skills identification. Such sources of data are generally provided by the United States Bureau of Labor Statistics, the U.S Department of Labor, the Bureau of Census or the Bureau of Economic Analysis. Each of these sources provides data based on national definitions and trends. Inferences of regional differences from such data are difficult to make. The reliability and quality of data for use at the regional level in the Passmore model adversely effects the outcome reliability and validity of the information.

Input Conflict

Passmore proposes to use the model to identify labor demand data. Yet Leontief's Model requires the labor demand data be a unit of input before it can be effectively used in policy development and evaluation. Thus results the paradox that in order for Leontief's Model to function, one must specify labor demand data based on the output demand, yet Passmore proposes to use the model to identify sub-unit labor demand data. If demand data is known prior to execution of the model, regression analysis for

employment projection, or potential industry surveys may be more beneficial in the determination of skill requirements for education and training purposes, rather than static input-output models.

Model Scope

Wassily Leontief was probably the first to apply production function analysis as a statistical method. The statistical model is assumed to be a linear function among and across both input and output variables. The general purpose and use of the model according to Leontief is that of national policy and economic planning. The variables and data used are most effective at the national level for describing interindustry commodity flows. It is questionable whether the model lends itself as a tool for policy and planning as proposed by Passmore.

Implications for Research

This model is useful as a rough tool and can be made more accurate by studies of production functions in particular fields. However, it is questionable if the model lends itself as a tool for policy and planning for education and training purposes. Further evaluation and validation should be empirically conducted on Dr. Passmore's Model prior to its adoption as a tool for education and training strategic planning at the regional level. Issues concerning the identification and validation of data sources associated with skills rather than labor should be undertaken.

Research should also be conducted to address the issues of emerging occupations (data sources) as well as the effects of technological change on skills requirements of labor within industry groups. The dynamics associated with labor skills might be too great for effective utilization of the Passmore's design without violating the assumptions of the original Leontief Model.

Additional study should be conducted to determine if factors can be identified which might assist in transforming sub-units of labor into a linear relationship without affecting the quality of information outcomes.

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Holistic Approach to Regional Strategic Planning

Glenn E. "Gus" Baker

David Passmore has the reputation of a fine researcher and an excellent writer, and his work, "Strategic Planning of Employment and Training for Regional Economic Development" reflects this reputation. The work is typical of Passmore in that it is thorough, concise, and detailed. His economic model appears to be rational and functional, and his examples plainly display the theoretical elements. Technically, Passmore has produced another superior work.

However, as Passmore pointed out in the discussions concerning his work, it focuses on developing employment potential on a regional sector rather than either a local sector or a specific industry. Developing models for regional sectors implies two considerations for those in training and development research. These considerations are: 1) Public sector effects – the implications and data relate to the public rather than the private sector. The scope is beyond a single corporate, government, or institutional entity; and, 2) Specialization – the development, and employment of an economic model to forecast and plan for these events is very specialized in terms of methodology, individuals, and the individual or entity which conducts the work.

For discussion purposes, each of these implications will be explored in detail. The discussions are simply that – discussions. There is no criticism intended or implied to Passmore or his work. These are simply discussions of facets or extensions of ideas within that work that may or may not have been considered. In some cases, they may lie beyond the scope of his paper which presents how a model is developed rather than who should do it.

Public Sector Effects

The implementation of regional models calls for concerted action from many groups to address broad economic problems caused from population migrations, technologically driven occupational shifts and obsolescence, and many other multi-faceted events. The models are developed from data which cuts across several sectors of an economy and the derivation of this data by one office may be a problem. Economists are as seclusive in their research as are researchers in other fields. Such diverse data could perhaps be more appropriately derived and interpreted using a more holistic approach employing a

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multi-disciplined methodology and an exchange of information and interpretations between and among many institutions, corporate groups, and government entities.

Research efforts in forecasting economic trends is perhaps more appropriate when conducted in the public sector. Because individual investigators from one discipline may not be familiar with methods in other disciplines, a team approach may be more desirable and effective in reducing inadvertent bias of data interpretation, inappropriateness of individual research methodologies, or insufficient emphases of data. In addition, the inadvertent lack of communications between or among interest groups about the interpretations and meanings that are suggesting actions could affect the efficiency and direction of change.

Simply adapting the methods of one field to another, while certainly innovative in a field, is not necessarily using a holistic approach that could assure cohesive and cooperative results for the best possible benefit to the broad population. Within the American context, those factors and events which affect the public sector are more commonly supported when there is involvement from several segments of the population. Thus, it is implied that: 1) investigative teams be used; 2) teams represent several disciplines; 3) communication between and among corporate, government and institutional groups should occur at several stages.

Specialization

Those of us in the University Council for Training and Development Research operate in a wide variety of roles which include: 1) Researchers in training and development; 2) Teachers of research in training and development. To examine Passmore's model within these considerations will instigate several questions, and one must question the appropriateness of Passmore's model to these roles. Should the model assume the preeminence of a major research skill appropriate for all professionals in the council? Should the model assume a place in the methodology taught to all individual and emerging professionals in the field of training and development?

The answer to these is "probably not." Passmore's research background and his continued personal growth has enabled him to work to excellent standards in many directions. To concurrently extend this concept to the present would suggest that emerging professionals should perhaps be aware of these possibilities but should not necessarily receive extensive training in them. They should, however, receive a broad familiarization and should be conditioned to look beyond their own boundaries and to build teams.

However, Passmore's model does show one overriding implication for both researchers within the Council and the training of researchers in all training and development areas. This is the inclusion of holistic concepts in research. First, researchers should be encouraged to be more multi-disciplinary and

thus more holistic in their research concepts. Doing their own research in the seclusion of their individual settings may not provide either information or politically approachable settings to effectively implement any findings which might have broad implications for the public sector.

Teaching emerging professionals the benefits of holistic approaches on such broad questions could encourage individual entities – whether corporate, institutional or governmental – to extend their interest and involvement beyond their own boundaries. Typically such extensions are not at the expense of the sponsor but to their benefit.

Further, the needs of the emerging professional will range widely. As the limits of knowledge expand, so too will methodologies expand and evolve. Research methods will include precise, quantitative techniques as well as subjective, qualitative approaches which may often be most effectively employed together. These research methodologies in both qualitative and quantitative aspects should continue to evolve and be refined. The term "holistic" thus assumes meaning for research teams and methodologies that has not been typical of research in the past. This implies that to fulfill the role of a teacher of research, that basic methodologies taught should be expanded – not necessarily to specific techniques such as the development of economic models – but to the inclusion of both quantitative and qualitative processes. Further, this training should soundly plant the seed for holistic and multi-disciplinary team approaches that extend beyond the boundaries of the host entity.

Yet another reason for expanding the scope of research is the complexity of today's society. Solutions to complex problems are unlikely to be rooted within a single discipline or methodology. Thus, the implementation of models or the activation of widespread policies would logically include proportionately wide involvement in order to succeed.

In closing, Passmore has both piqued the interest and challenged the methodology of his peers. While the method he suggests is not appropriate to each researcher in their own individual setting, the knowledge of such a model should be construed as both necessary and vital to a holistic and functional ability to expand beyond one's own narrow boundaries.

A Private Sector Perspective on "Strategic Planning of Employment and Training for Regional Economic Development"

Gary N. McLean
Richard A. Swanson

Passmore's paper has been developed in the context of a number of assumptions that reflect a perspective that may not be highly valued by private sector training and development professionals. This paper will explore some alternative views.

Public/Private Sector

Passmore's paper emphasizes the public sector, specifically that of an economic development organization, the Ben Franklin Partnership Fund. It is our position that a private sector perspective of economic development is more aligned with the purposes of the University Council for Training and Development Research.

Collective/Single Firm Action

Further, the model presented, and the basic assumption of most economic development models, is that firms somehow act as a collective for the greater good of the region, state, industry, or nation. It is our assumption that a company will operate out of what it perceives as its own best interest. In the Tinkerland example, Passmore (p.23) suggests that the relocation of a toy manufacturing facility would add 95,327 jobs. He goes on to forecast these new employees coming from three sources: (1) the local, unemployed; (2) the local people who are currently out of the labor force; and (3) in-migration. He then raises the possible need for employee training as a planning factor. What is not considered is the possibility, perhaps even probability, that the toy manufacturer would look at compensation rates in the community and outbid the local competition. If the community has depressed wages/salaries, it may conclude that it can establish itself in that community, offer slightly higher compensation, hire employees who are already trained, and put existing companies out of business because they cannot compete at that compensation level. In this scenario, the net effect for the community is a decrease in employment

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in the community, with the interindustry multiplier effect actually adding to a spiralling decline in community-wide employment.

Model Objective: Simulation/Real-life Decisions

It appears that Passmore intends for the model to be used for projecting the "amounts and kinds of labor needed to fulfill regional economic development plans" (p.27). While he acknowledges that interindustry analysis does not promote a "quick fix for regional economic and employment problems," he also states his belief that the model can be informative about "direct and indirect economic employment consequences." In addition to the concern about how individual firms make site decisions, there is also a concern about whether demographic data will stand still long enough for the model to operate effectively. As illustrated, the model portrays the environment as static, and we assume it to be dynamic. Some industries change rapidly, especially in the generally considered more desirable high technology areas. Identifying relevant variables is difficult enough; finding current values for those variables, and then assuming that their relationship will remain the same, becomes very difficult on an interindustry level. Passmore identifies some important factors that exist in the economic development process, particularly in exploring the multiplier effect. The systems theory perspective notes that a change in one aspect of a system will often create unpredicted changes in other aspects of the system. Thus, the Passmore model can be useful in providing a simulation of possible effects, either for decision-makers in the public sector, or for students in public administrations and business administration. Such simulations can help attune professionals to the extent of unplanned effects from any system change. But no matter how much homework an economic development organization does, and no matter how current and comprehensive the input data are, the interindustry model is not going to predict the influence individual firm response. So long as individual firms retain the right to make their own decisions, the proposed model will not impact real-life industry decisions but, at best, can serve as a simulation.

Decision-Making Processes

As a follow-on to the previous sections, we would like to focus more on the decision-making processes used by the private sector. We have discussed the static nature of the interindustry model as compared with the dynamic nature of most businesses. From the perspective of a private sector manager, good managers will use economic theory as only one piece of the decision-making process. As Mintzbert (1975) and Kotter (1982) have both identified, there are many factors involved in the decision-making process of most managers, including intuition, fragmented planning, networking, and just plain serendipity. That is, in spite of rhetoric about rational management, much of management decision-making is irrational. Yet, the interindustry model rests on the assumption of a rational model. Further, the model seems to operate on the premise that:

Input --->Output

rather than the more complete description of

Input --->Process --->Output.

The process component that is omitted from the supply/demand premises of the interindustry model can have a very significant impact on company decision-making and, ultimately, the economy. The model, in fact, assumes a static number of employees required per unit of output. That is not necessarily the case. Improving the process can often reduce the employees to unit of production ratio and will often happen in economic downturns or when the desired number of employees is not available. Thus, the interindustry model, again, incompletely reflects industry reality.

Corporation Objectives: Job Creation/Return on Investment

A major distinction between a public and private sector perspective is the desired end-goal of economic activity. The interindustry model speaks to the desired objective of increasing employment by creating jobs – the model's objective is to "determine the effects of reordering priorities for final demand on occupational employment in each industry: (p.20). This is a valid goal for government decision makers, and the more nationalized (or quasi-nationalized, as with the defense industry) the industry, the more accurate the model might be. However, the primary goal of companies in a free-enterprise economy (and recognizing that such an economy does not fully exist) is to maximize return on investment (ROI) within legal and ethical constraints. Thus, while government policy might will support the goals of the application of the interindustry model, to be effective, major changes would be needed in government policy to restrict or control corporate decisions, especially around freedom to locate and relocate on sites that would not otherwise be selected. One of the ways in which this has been done has been through: tax vacations or at least preferred tax situations, the provision of training facilities, provision of high quality infrastructures (such as water, sewage, highways, and other support systems), reduced utility charges, and so on. Thus, while employment factors, such as suggested by the interindustry model, would be one factor in a company's location decision, it is only one factor in many. A holistic perspective for maximizing ROI is the desired objective for companies. Yet, given that managers do not make rational decisions, the reality is that managers will choose those components of the business environment that they feel are most important and will base their location decision on those factors--which may, then, lead to a decision heavily influenced by employment factors or to a decision that almost totally ignores this factor!

Ethnocentricity

A key problem facing both individual companies and individual economic development organizations is their own tendency toward ethnocentrism, that is, their own inclination to look out for themselves. Companies, as described earlier, seek to maximize their ROI--not that of their competitors and only occasionally that of their industry, region, or nation. Likewise, economic development councils are also self-centered. They are interested in developing their city, county, region, state, and even country. This is not unique to the United States – it is found in countries throughout the world. The interindustry model supports an ethnocentric model for economic development (how do we improve employment in our region?), while assuming at least a regio-centric (what's best for our region?) perspective for an individual company. While some few companies are likely to be any less ethnocentric than the economic development council is.

Social Responsibility

In his concluding section, Passmore refers to "providing fulfilling work and sufficient income for all citizens" as a "moral, ideological problem" (p.27). The assumption that supports the use of the interindustry economics model is that industry responds to economic drivers. The "River of Butter" scenario, in which the classical guns vs. butter dilemma is raised, is analyzed solely from an economic perspective. And while it appears valid that most of the emphasis within companies is economic (see earlier discussion on ROI), it is also true that at least some companies have overtly adopted social responsibility goals as part of their mission. The members of the "Five Percent Club" in Minnesota, for example, have made a commitment to donate five percent of their annual net income to charitable organizations. Passmore had adequately recognized the limitation of an economic model alone to describe the decision-making process. In the "River of Butter" scenario, even though the lowest employment payoff comes from the social programs proposed, there might still be good arguments for the public sector to argue for such a production shift because of supraordinate values, such as peace.

Training Focus

Finally, Passmore seems to avoid the thrust of the second half of the title of his paper--that of training. His references to training are reserved for his last two sentences. And even then he says that "detailed information about sources of labor supply" would be needed to decide "whether training actually is necessary to create the human capital needed" (p.27). Yet his paper focuses on labor supply rather than labor demand, and no indication is given to how training needs are assessed.

Conclusion

While Passmore's paper can serve a valuable role within certain academic sectors (e.g., economics, public administrations), it appears to be of less value to those whose primary interest is in training in the private sector. As reviewed in this paper, some of the assumptions and concepts run counter to those made by companies in the private sector. It would be very useful to adapt the model to the private sector and to revise it based on assumptions that are acceptable to both public and private sector organizations.

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Tinkerbell's Response

Walter A. Cameron

My initial reactions to Dr. Passmore's presentation is similar to what Yogi Berra said about Don Mattingly's performance. "He has exceeded my expectations and done even better". Not only has he selected a model and shown its application potential but has developed the computer tools for its use. He did an excellent job of using some creative approaches to simplify some complex concepts dealing with labor economics. This is an illustration of the type of development work we need more of in the area of training and development. As the old cucumber farmer use to say "there nothing new in cucumbers but freshness does count."

However, if a Tinkerland did exist, it would have to be run by Tinkerbell, not Dr. Passmore. I don't believe there is a Tinkerbell and in the real world, there is nosuch place as Tinkerland!

The labor economics model I know of that works every time is credited to Calvin Coolidge. When asked about his knowledge of labor economics, he was reported to have replied: "one thing I know is that when a large number of men are unable to find work, unemployment results."

We might say of this simplistic model: "The cause is hidden – but the result is well known." A classic example of the Type III error - Define the question after finding an answer. It never fails.

I will explore at least three major concerns that I perceive to be a major weakness of the interindustry model and which apply even more to the basic input-output model from which it was derived. The first concern is the underlying assumptions upon which the model is based. These assumptions point to things that probably only occur in Tinkerland. Dr. Passmore provided the following:

> Assumption 1 - There is a fixed and stable relationship between the input and the level of output of an industry or sector of the economy.
>
> Assumption 2 - There is also a rigid relationship between the occupational structure and the educational qualifications of workers.
>
> Assumption 3 - If these first two are true, it is therefore possible, and desirable to make long-term forecasts of future levels of output and the occupational structure and education qualifications of the labor force that will be needed to produce the output.

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The data that are currently available for input is the second concern. By any stretch of the imagination, it is at best guesses. This factor is greatly increased by technological changes that are ongoing today.

The third concern is that the elasticity of substitution is a critical factor which is not controlled in this model. As reported by Dr. Passmore it was assumed to be zero.

With respect to the assumptions underlying the interindustry model, the sparse research on whether the relationship between input and output is fixed or flexible is hotly debated. What has been put forth is that when applied on a broad basis (such as the U.S. as a whole) there does appear to be a somewhat stable relationship. However, as the model is applied to smaller segments of the economy, such as states or regions, the relationships become more volatile, and more flexible.

Even when the interindustry model has been used in a somewhat closed, controlled environment – the military complex – there have been problems. I have not been able to obtain military reports on their use of this model. Therefore, my information is based on conversations with two civilian labor economists who work for the Army. They indicated there is a tremendous problem in getting timely employment data from the different branches of the armed services and that the discrepancies in information is great. Also even when they had calculated elasticity of substitution there were still enough problems to concern them. In summary, the military economists felt fairly confident in overall forecasting for the Department of Defense, but were less confident when forecasting for specific service branches or segments of branches.

The data we have on the state level and the regional level throws one into shock when you think of the gaps that are present. Using the Bureau of Labor Statistics' data gathering methods, it takes a state approximately one year to gather the data and another year to massage it. In many cases, the information is three years old when reported. Additionaly, the variability in individual business and industry response to the data collection instrument is haphazard. How many personnel directors or human resource directors can classify their companies jobs into the 1200 plus Occupational Employment Codes? As a result, we get out-of-date information which consists of "educated guesses" at best. When we consider the new small business startups, this further complicates the situation. How much of the information on new businesses gets into the system? If you wish some more food for thought on the economic changes we are undergoing today, read David Birch's book entitled: "Job Creation in America" and also look for the book entitled "The Great Job Shakeout" by Marvin Cetron and Owen Davies to be released in September, 1988. The Great Job Shakeout is composed of ideas for career planning in tough economic times.

Looking at the second concern of weak data makes our use of it fall into Augustine's Law of Data (Augustine, 1986) which is: "The weaker the data available upon which to base one's conclusions, the

greater the precision which should be quoted in order to give the data authenticity." Due to our problems with input data the sad fact is any economic forecasting model is going to be faced with the garbage in and garbage out phenomena.

Third, the elasticity of substitution - between more and less education workers (or other inputs) has been at the center or analyses of demand for educated labor for two reasons. First because the validity of widely used "fixed coefficient" methods for forecasting educational demands or "needs" and the potential economic worth of educational planning to meet such demands or needs hinges critically on the size of the elasticity (Psacharopoulos, 1985). Standard "fixed coefficient" forecasts methods assume zero elasticities of substitution in order to focus on the impact of changes in the compositions of industries on the demand for trained workers. The greater the actual elasticities, the less valuable are such forecasts. Similarly, planning education to meet future labor market demands is useful only if elasticities of substitution are small; if the elasticities are large, employers can readily substitute less educated for better educated labor, so that even accurate planning will be of little economic value (Freeman, 1967). Second, the elasticity of substitution between more and less educated labor is important in analyzing the impact of changes in relative supplies of educated workers relative to less educated workers will have little effect on their relative wages. When the elasticity of substitution is small, large increases in the relative supply of trained workers will cause sizeable changes in relative wages and thus will alter the distribution of earnings (Bowles, 1969).

Compilations of studies by the World Bank over the past few years have pointed out some information about the results of the use of the input-output model for manpower forecasting (Psacharopoulos, 1973; Tinbergen, 1987; Williams, 1987). These are:

1. Workforce forecasting is good for about 5 years at best.
2. Workforce forecasting needs to be effective for at least 15 years to be beneficial for education or training planning.
3. Non labor inputs (for example physical capital) are more complementary with educated than with less educated labor.
4. Labor saving technical progress is less biased against more highly educated labor.
5. Commodities that are more intensive in the use of educated labor are also more income elastic.

Where do jobs come from? I believe jobs come from people—jobs are of the people, by the people, for the people. As Dr. Passmore implied, people are what human resources development is all about. Economic models provide a small sub-system for human resources development. On a national scale it could be useful in providing information which would be helpful in establishing a national policy for human resource development. The U.S. is in dire need for a national human resources development

policy, not the policy by default under which we now operate. We need a policy which will establish the superstructure for:

1. The achievement of the fullest development of the productive capacities of human beings.
2. Optimal allocation of resources to assure individual productive fulfillment.
3. Prevention of wasteful human resources utilization.
4. Maintenance and conservation of human resources. (Parnes, 1975)

In summary, I believe if a sufficient number of economic models are superimposed on top of each other, it can be assured that economic disaster is not left to chance. If Noah were alive today, he would find no need to build an ark, he would need only to hire an economist and ask him or her to design a model for predicting rain.

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